d.) Remarks

In the present Action, claims 1-30 are rejected under §112 regarding the definition of the term "passive shape memory alloy." The application makes many references to actuators that employ SMA elements for motive power, and are actively powered by ohmic heating to produce a power stroke. There is specific reference (paragraph 0005) to US patent no. 6,326,707, which describes several different embodiments of actively powered SMA actuators. In paragraph 0008 the over-temperature release device (OTRD) is introduced, and is described as a passive device that operates when ambient temperature exceeds the onset temperature of the powered actuator. Paragraph 0011 describes three embodiments employing passively heated SMA wires, and specifies that they are bathed in the ambient environment. A clear contrast is made consistently between the passively heated wire of the OTRD and the actively heated wire of the actuator itself. This descriptive distinction is carried on throughout the application, and it is asserted that the term passive shape memory alloy has been fully explained in the application.

Claims 1-14 and 24-25 stand rejected under §102 over the Johnson patent. Johnson describes an automatic sprinkler head for a fire suppression sprinkler system that employs two separate SMA elements in its operation. In that one regard the Johnson assembly is similar to the present invention. In all other regards, it is completely different from the invention. Because of the notable distinctions discussed below, this rejection is respectfully traversed.

In Johnson, the two SMA elements are a large coil 17 and a smaller coil 52. The SMA coil 17 contracts upon heating by ambient temperature above @120°F, but this action has no immediate effect. Rather, contraction of the coil 17 creates a space within the valve that permits later actuation of the valve, and sets or "cocks" the reset mechanism that ultimately closes the valve after it has been operated. Note col. 5, lines 50-59: "At an ambient temperature above a given level, for example 120° F., the transition temperature of the alloy coil 17 is reached causing it to contract into a form having an axial length substantially less than the spacing between the housing retainer disc 27 and the coil retaining flange 39. However, the valve 12 is retained in a closed position by the latch arms 14, the hook portions 42 of which remain engaged with the outer surface 44 of the deflector plate 33."

A separate temperature sensor 16 has the SMA coil 52 which expands when it reaches @135°F, forcing piston 67 upwardly into opening 68. This movement separates rods 65 outwardly, driving hooks 42 outwardly and freeing the valve 12 for movement. The previous contraction of SMA coil17 creates space to enable retainer flange 39 to move downwardly when hooks 42 release, so that the valve 12 may be opened. It is very significant to note that neither SMA element actually opens the valve; rather, the water pressure in the pipe drives the element 12 to the open position. See col. 6, lines 4-6: "Accordingly, the released valve 12 assembly is moved by the fluid pressure within the passage 19 into its open position shown in FIG. 4."

The instant rejection states that actuator 17 drives the valve element in a first

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direction, but this is a complete mis-intepretation of the reference. The fluid pressure in the pipe is required to actuate the valve after the latches 42 are released by activation of the SMA coil 52. Even the embodiment of Figure 5 relies on water pressure to move the valve element to the open position.

The primary role of the SMA coil 17 is to close (reset) the valve after the valve has cooled. See col. 6, lines 35-43: "This expansion of the alloy coil 17 exerts a force between the housing retainer disc 27 and the coil retainer flange 39 moving the flange and the struts 37 upwardly in the annular chamber 25. The upward movement of the struts 37 pulls the attached valve assembly 12 into its closed position sealing the outlet opening 22 and thereby terminating the flow of extinguishing fluid."

The present invention is distinguished from the reference in the broadest sense by the fact that the invention provides an SMA actuator that is designed to be activated by ohmic heating upon selective application of current to the actuator, and a passively actuated SMA mechanism responsive to ambient temperature to prevent unwanted operation of the active device. In Johnson, both SMA elements are passively operated (by increases in the ambient temperature). Indeed, in Johnson both SMA elements are required to be activated by ambient temperature before the valve can open. In contrast, the invention employs one (passive) SMA assembly to prevent delivery of the output stroke of the other (active) SMA device. Johnson has no SMA element that is designed to be intentionally activated. Thus a crucial aspect of the invention is completely absent in the prior art.

Note that the application describes a safety mechanism, and includes (paragraph 25) a definition of "safety" as "a device designed to prevent a mechanism from being operated unintentionally, for example, one that keeps a gun from being fired by accident or an elevator from falling." The safety concept and function is completely absent in the Johnson reference.

These distinctions are included in the original claims, and have been pointed out more particularly by amended claim 1. Claim 1 now recites a safety mechanism for an actuator, and removes the actuator recitations from the preamble and places it in the body of the claim where it is clearly a claimed element of the invention. It now states that the actuator has at least one active SMA component that is selectively heated to deliver an actuating stroke. This structure is completely absent from the Johnson reference. Claim 1 then goes on to recite the passive SMA component that responds to an overtemperature condition, and means operated by the passive SMA component to prevent delivery of the actuating stroke of the actively operated SMA actuator. Johnson does not show nor suggest this safety feature, and claim 1 is clearly allowably over the art. Claims 2-4 depend from claim 1, further defining that patentable recitation, and are likewise allowable. Note that Johnson describes none of the structures of claims 2-4: decoupling the actuator output from a load, or releasing the actuator from a mechanical ground to prevent the transmission of force to a load, or connecting the safety mechanism in countervailing effect to neutralize the SMA active actuator output.

Claim 5 remains in original form, since it recites a displacement multiplied actuator driven by selectively activated shape memory alloy components to deliver an output stroke. It recites the passive SMA component exposed to ambient temperature, and means operated by contraction of the passive SMA component for preventing delivery of the output stroke of the displacement multiplied actuator. Johnson has no counterparts to these structures, and claim 5 should be allowed. Likewise, claims 6-30 are dependent from claim 5 and further refine that patentable structure, and are also patentable.

The double patenting rejection of all claims is primarily dependent on the Johnson reference. Given the amendment to claim 1 and the lack of a relevant teaching for the safety mechanism of the invention in the Johnson reference, it is asserted that the double patenting rejection should be withdrawn, and all claims allowed.

It is asserted that all claims now presented are allowable, and that this